

SOME NOTES ON COLIAS AND BRENTHIS
(LEPIDOPTERA, PIERIDÆ AND
NYMPHALIDÆ)

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This paper consists largely of the record of a collecting trip made during the summer of 1935 by Professor Herbert Ruckes and myself, through New Mexico, Colorado and Wyoming, and especially of notes and observations on the two butterfly genera, *Colias* and *Brenthis*, which I hope some day to monograph. The remainder of the butterfly material from this trip is in the collection of Mr. C. dosPassos.

Colias and *Brenthis* present problems of great taxonomic and zoögeographic interest. In common with a considerable number of other butterfly genera they are Arctic in origin, and contain many species common in greater or lesser degree to the Palaearctic and Nearectic.

There is a popular idea that our North American butterflies are very well known scientifically, but this is not so. Far less is known in detail about the butterflies than about many other groups of insects, in spite of (and possibly in part because of) the great popular interest in the group. I therefore take the present opportunity to point out important gaps in our knowledge of various species of these two genera. Probably some of these gaps may be filled by a study of specimens now in various private collections, and in museums which I have not visited; but for others collecting and life-history work will have to be done at strategic locations. Any additional information which may be made available for me will be greatly appreciated.

LOCALITIES VISITED IN 1935

To save repetition the localities in which collecting was done in 1935 are here described at some length. In a number of cases directions for reaching these are included, as these will prove of value to other collectors desirous of visiting these places, some of which are type localities.

LITTLE TESUQUE CANYON, SANGRE DE CRISTO RANGE,
NEW MEXICO

The locality in which collecting was done lies at 8000–8800 ft. altitude, near the head of Little Tesuque Creek, a few miles north-east of Santa Fe. The region has recently been designated as the Hyde State Park, and an improved road is being constructed up from Santa Fe. It is in middle Canadian Zone, lying in the central part of the coniferous forest belt. In the moist valley the forest of Yellow Pine (*Pinus ponderosa*) gives way largely to firs; but on the steep hillsides, where the run-off of water is great, the pines predominate to considerably higher elevations. The majority of the butterflies are to be found in the small, grassy meadows in the valley, although some, such as *Polygonia* ssp., *Basilarchia wiedmeyer*i, *Pieris napi*, etc., prefer the shaded woods, and others, such as *Hypaurotis chrysalus*, prefer the thickets of Chaparral Oak (*Quercus gambeli*).

ASPEN RANCH, SANGRE DE CRISTO RANGE, NEW MEXICO

Like Little Tesuque Canyon, this locality is on the western side of the mountain range; it is a few miles further north than Little Tesuque Canyon. The environment does not differ essentially from the description above. Around Aspen Ranch many of the mountain sides were burned off, about forty years ago, I believe. The faster-growing Quaking Aspen has repopulated these areas, and is only very slowly being replaced by sparse growths of climax conifers. In June, 1935, the aspen groves were being very severely attacked by the western tent caterpillar, whole hillsides being defoliated, and the spruce bud worm was very plentiful in the conifers, so that the trees were having a hard time.

WINDSOR CANYON, COWLES, NEW MEXICO

Cowles is located nearly at the end of the road that leads north from Pecos along the Pecos River, a mile below the Panchuela Ranger Station; at this latter place we made our base camp. This is on the east side of the main Sangre de Cristo ridge, nearly opposite the localities described above. Windsor Creek flows eastward from Santa Fe Baldy Peak ("Baldy Peak" on the U. S. Topographic map, Santa Fe Quadrangle) and at Cowles joins

the upper waters of the Pecos. Up Windsor Canyon runs a Forest Service trail, with branches to Santa Fe Baldy and Lake Peaks, which leads westward across the range to Santa Fe.

Collecting at Cowles and in Windsor Canyon was done in the grassy, well-watered fields and meadows. The effect of the dry winds from the west is well illustrated by a comparison between this locality and Aspen Ranch on the western side of the range; for at the latter locality the winds, bone-dry from their passage over hundreds of miles of desert, take on moisture, while here they discharge it. As a result Cowles has a much more luxurious true Canadian Zone flora and fauna at a lower elevation than Aspen Ranch at a higher elevation. Cowles is at about 8000 ft, elevation; at Aspen Ranch Transition and lower Canadian Zone elements are found on the dry hillsides even up to 10,000 ft. It is thus seen to be moisture, and not merely temperature, that here largely determines the lower limits of the coniferous forest, although of course these two factors are largely interdependent.

SANTA FE BALDY PEAK

Along the trail up from Cowles (see above) one passes through heavy Canadian Zone coniferous and aspen forest, with occasional small, grassy meadows or "parks." Timberline on Santa Fe Baldy occurs quite abruptly at about 11,700 ft., the trees extending on comparatively gently sloping ground nearly to the margin of the small lake that lies within the curve of the cirque of the peak. Around this lake are some nearly level, grassy meadows. From here, steep, grassy or boulder-strewn slopes lead upward for several hundred feet rise in elevation to the long, curved, barren ridge of the peak. A noteworthy series of *Oeneis*, many of them quite worn, was taken on the very top of this ridge by Mr. Richard Whitmer of our party. The species has been determined as *O. brucei* Edw. by Mr. dosPassos. None of these butterflies were seen at all below the very crest of the ridge.

Santa Fe Baldy and Lake Peaks, together with Truchas and Jicarilla Peaks further north, probably represent the southernmost extension of any sizable areas of Hudsonian and Arctic Alpine Zones in the continuous Rocky Mountain chain, and so are worthy of a great deal of careful study and collecting.

ROCK CREEK, VIC. OF COLORADO SPRINGS, COLORADO

Collecting was done in the grassy meadows near the Fountain Valley School cabin, at about 8400-8800 ft. altitude. This was in the middle of typical, heavy, Canadian Zone coniferous forest, *Pinus ponderosa*, *Abies concolor*, *Picea pungens*, *Pseudotsuga mucronata* and *Populus tremuloides* being the dominant trees. Nevertheless, *Yucca glauca* occurs here, and such tropical butterflies as *Nathalis iole* and *Eurema mexicana* are common and well established.

HALL VALLEY, COLORADO

For directions for reaching this famous collecting locality, important because of the work of Bruce, Snow, W. H. Edwards and Barnes, I am indebted to Mr. F. M. Brown. Hall Valley is located in the extreme northwest corner of Park County, and may be found on the Montezuma Quadrangle of the U. S. Topographic maps. It can be reached from the "town" of Webster, which is located on U. S. Highway No. 285, about 14 miles west of Bailey.

Hall Valley is a long, narrow valley that extends up from lower Canadian Zone meadows at Webster, and ends in a large area of Hudsonian and Arctic-Alpine Zones. At the upper end is a striking cirque of about 11,500 ft. altitude, which is rimmed by the high ridges of the Continental Divide reaching heights of 12,500-12,952 ft. Timberline occurs in the valley floor at 10,700-11,000 ft., although growths of greatly stunted spruce push somewhat higher on some of the slopes. In the upper end of the valley are large areas of grassy meadows and low willow brush; the steep slopes of the valley sides are covered with short herbage in between areas of rocky slides; and the remnants of an ancient peneplain that form the tops of the encircling ridges are typical, Arctic-Alpine, short-grass tundra. Many bog areas occur in the valley floor, both above and below timberline, and there are frequent beaver ponds in the course of the rapid stream that flows down the valley.

I know of no more attractive locality in the Colorado Rockies than this, combining as it does accessibility with inspiring scenery and excellent high-altitude collecting. It is the type locality for a number of butterflies; and it should be an ideal place for some much-needed ecological and life-history studies.

PINGREE PARK, COLORADO

Pingree Park is a large, grassy meadow, or "park," located near the peaks of the Mummy Range, west of Fort Collins, Larimer County. It may be found on the Home Quadrangle of the U. S. Topographic maps. It is reached best by automobile road from Fort Collins, *via* Poudre River Canyon. Pingree Park lies at 9000-9500 ft. elevation, in the middle of Canadian Zone forest belt. Here, every August, is held the annual meeting of the Rocky Mountain Entomological Conference. I can well attest that a visit to this meeting will repay a visitor manyfold in knowledge gained from the scientific programs, in acquaintance with some very excellent territory, and in pleasant friendships.

MUMMY PASS, ROCKY MOUNTAIN NATIONAL PARK,
COLORADO

About 8 miles from Pingree Park, from which it can be reached by trail, Mummy Pass lies at an elevation of 10,500-11,400 ft., in the extreme northern part of the Rocky Mountain National Park. Ascending from Pingree Park, the forest belt ends rather abruptly with a scattering of *Picea*, *Abies* and *Pinus flexilis*, so that Hudsonian Zone is rather limited. There is a very large area of grassy, Arctic-Alpine tundra, with occasional willow bogs. On the peaks (Comanche Peak, Mummy Mt., Hagues Peak and Hallett Glacier) on either side of the pass are steep, rocky slopes where vegetation often maintains a precarious foothold, and where Pikas and Ptarmigan abound. It is a long, stiff trip up from Pingree Park and back on foot, but an entomologist will be repaid by some excellent high-altitude collecting in season.

SNOWY RANGE, WYOMING

During the week of July 17-23 we stayed at the University of Wyoming Summer Camp, where excellent geological and biological laboratories are being completed. This is ideally located near the upper limit of the coniferous forest, in the Snowy Range at the northern end of the Medicine Bow Range. An excellent motor road is now being constructed westward from Laramie across the Laramie Plains to Centennial; hence it crosses the Snowy Range, passing through many miles of very beautiful Hudsonian Zone,

drops down on the west side of the range, and connects with the road to Saratoga and the Lincoln Highway at Walcott. There are now few more accessible localities in the Rocky Mountains than this, where high altitude collecting may be done at the running board of one's car, so to speak; and any entomologist who visits the Snowy Range will be well repaid for his efforts.

The season was very late here in 1935, as elsewhere also, so that during July many species were found just beginning to emerge that normally would have been flying in quantities. A return visit to the Snowy Range was paid on August 13, and much interesting data secured regarding the seasonal succession of many species.

The Snowy Range may be located on the Medicine Bow Quadrangle of the U. S. Topographic map.

MIDDLE PINEY LAKE, WYOMING RANGE, WYOMING

Reached by a rather poor road westward from Big Piney, Sublette County, Middle Piney Lake lies at 8818 ft. altitude, in about middle Canadian Zone. The grassy meadows and mountainsides around the lake offer interesting collecting; while Wyoming Peak and its surrounding buttresses, rising to considerable areas of Arctic-Alpine Zone, present some very interesting zonal distribution problems. Near the foot of the lake a very large area of slide rock has come down from the mountain to the southeast, and forms thus a continuous connection between the middle Canadian Zone meadows of the lakeshore and the Hudsonian areas on top of the mountain. A number of species that are normally found only in the rock slides above timberline have here spread downward, offering a very interesting example of intrusion. The Pika (*Ochotona*) is thus found in this rock slide surrounded at a short distance by typical middle Canadian Zone flora and fauna; and a specimen of the normally Arctic-Alpine Copper butterfly, *Lycaena snowi* Edw., was taken on a rock pile near the lakeshore. Such cases lead one to suspect that it is the immediate environment, rather than any larger "Life Zone" influence, that largely determines the distribution of such organisms. Both the species mentioned above may be termed "petrophiles," for they are seldom if ever found away from the imme-

diating neighborhood of large masses of broken rocks; and probably they will, within reasonable limits, be found wherever this type of environment occurs, regardless of minor Life Zone differences.

This does not, however, invalidate the entire Life Zone theory, as some ecologists would insist. There must be thousands of square miles of slide-rock territory in the Rocky Mountains that should be perfectly suitable for such petrophilous species as Pikas, *Lycaena snowi*, *Erebia magdalena*, etc., yet which, lying in lower Canadian or Transition Zone, will never be occupied by them. In such cases the change would be too great. These species are sufficiently adaptable to make successfully the change from Hudsonian to upper or middle Canadian Zone, and even when circumstances allow, I do not doubt, to lower Canadian. But beyond a certain limit they cannot extend. Temperature is without a doubt, a large factor in this; but there must be others. And it is the sum of all these factors that determines the ecological category which we term the "life zone." Like most sweeping ideas the Life Zone Theory has suffered as much at the hands of overenthusiastic friends as from opponents; but this is no reason for throwing it away *in toto* and descending into a welter of minor, unclassified "associations" as some ecologists would.

Wyoming Peak and Middle Piney Lake are to be found on the Afton Quadrangle of the U. S. Topographic maps.

The Wyoming and Salt River Ranges are of especial interest to the taxonomist and zoögeographer. They probably represent the southernmost limit of distribution of many northern species and subspecies which, having spread southward through the Yellowstone Park, Teton, Snake River and Hoback Ranges, are here prevented from further extension of their ranges by lack of suitable mountain connection. A road up Greys River, which lies between the Wyoming and Salt River Ranges is, I believe, in process of at least partial construction by the C. C. C.; if it does not result in bringing in a swarm of firebug tourists, this should be of great value to scientific collectors.

GREEN RIVER LAKE, WIND RIVER RANGE, WYOMING

Green River Lake, located about 50 miles north of Pinedale, is at the head of the Green River; it may be located on the Fremont

Peak Quadrangle of the U. S. Topographic maps. The lake lies at an elevation of 7958 ft. and is nearly at the bottom edge of the coniferous forest. Transition Zone sagebrush and *Potentilla* "flats," and grassy meadows extend up the valley bottom to the lake; and a heavy Lodgepole Pine (*P. murrayana*), Spruce and Fir forest covers the Canadian Zone mountain slopes, extending down to the shores of the lake. Trails lead from the lake up neighboring mountains, as well as into the heart of the as yet unspoiled Wind River Range. We climbed Little Sheep Mountain (alt. 10,175 ft.) on the west side of the valley, and Mt. Osborne (11,905 ft.) on the east side. Little Sheep Mountain barely reaches to timberline, but excellent collecting is to be found in the grassy meadows and parks traversed during its ascent. On Mt. Osborne the timberline occurs at about 10,500 ft. Just below timberline the spruce-Douglas fir forest gives way abruptly to a narrow, upper belt of White-barked Pine (*Pinus albicaulis*). Above this is a large area of grassy and rocky Arctic-Alpine tundra, where excellent collecting may be had. At the date we reached this no *Oenis* were flying (Aug. 5), but an excellent series of *Erebia callias* Edw. was taken, the species being sharply limited to upper Hudsonian and Arctic-Alpine Zones. *Erebia sophia ethela* Edw. was common also, but limited to Canadian Zone meadows.

To many friends, both old and new, Dr. Ruckes and I are indebted for help and advice on this trip. In particular I wish to express my appreciation of the splendid work being done by the Rangers of the U. S. Forest Service, in preserving as best they can the forests of our West, and at the same time in opening up new trails and in keeping old ones passable. Of course, too much can be done in the matter of encouraging the general public to penetrate these forest areas; the fire hazard is enormous at all times, and a careless tourist can do almost irreparable damage with one match. In some parts of the west, recent, politics-inspired, "public works" programs are in this way opening up large forest areas to the public without making adequate provision for their protection. But among the men of the Forest Service I have never failed to find a desire for true conservation,

based on knowledge gained in the field and not in a desk-chair; and the interest of these men in scientific work, and their unfailing courtesy and helpfulness, are things that I shall always remember with deep pleasure and appreciation.

Colias meadi Edwards

Large series of *C. m. meadi* were taken in the Snowy Range, July 17-23 and August 13, and at Mummy Pass, August 18 and 20, where this fast-flying species abounds in Hudsonian Zone tundra, and is somewhat less abundant in Arctic-Alpine Zone. All the July specimens were freshly emerged; in both localities collected in August the majority of the specimens taken were still very fresh, although some were rather worn.

According to my experience *m. meadi* is largely limited to the shadeless, grassy meadows at and above timberline; of many hundreds of specimens which I have taken, and of more hundreds which I have seen, but few have been in meadows of the Canadian Zone forest belt. Not only does *m. meadi* almost certainly never breed in Canadian Zone, but adults blown down below timberline lose no time in flying back up again. Probably a very strong positive phototropism or "heliotropism" is responsible for this.

Series of specimens referable to *C. meadi elis* Edw. were taken in both the Wind River Range (Little Sheep Mt., July 25-Aug. 7, and Mt. Osborne, Aug. 5) and the Wyoming Range (vic. Middle Piney Lake and Wyoming Peak, Aug. 8-12). The chief characteristics of *elis* as compared with *meadi* are as follows:

(1) greater size; (2) lighter orange ground color above, especially in the males; (3) larger size of the spots in the black marginal borders of the females; (4) less greenish-fuscous suffusion on the under side of the secondaries of the males; (5) a less well-marked discal spot on the under side of the secondaries, due to reduction in width of the purplish-pink area surrounding the spot; (6) a more northern distribution—see below.

It is probable that the Wind River, Wyoming, and Salt River Ranges mark the southern limit of distribution of *elis*, which ranges northward into Alberta and British Columbia, and possibly Alaska. The Snowy Range undoubtedly marks the northeastern limit of *m. meadi*. I have seen no material from the Uintas or other Utah localities, so cannot be sure of the northwestern limit of *m. meadi*, or the southwestern limit of *m. elis*.

More marked than most of the color and pattern differences between *m. meadi* and *m. elis* is the difference in habitat of the two races. *Elis*, though ranging as far up into Arctic-Alpine Zone as *meadi*, is at times to be found common in middle Canadian Zone meadows and parks, entirely surrounded by heavy coniferous forest. At Middle Piney Lake, numerous specimens were seen and many taken, visiting *Helianthus* blossoms in typical Canadian Zone meadows and unforested hillsides; the center of abundance of the species was, however, somewhat higher up, in lower Hudsonian Zone. The same thing was noted in the Wind River Range, and here several specimens were taken even as low as at the edge of the sagebrush plains that cover the valley floor at about 8800 feet altitude. In the course of considerable experience with *m. meadi* I have never seen this, although doubtless specimens of the latter race do occasionally stray down-mountain for considerable distances.

Colias eurytheme Boisd.

Various forms and broods of *eurytheme* were taken everywhere that collecting was done. In its zonal as well as its altitudinal range *eurytheme* is the most widespread of Nearctic *Colias*, occurring commonly in all Life Zones, as well as from Alaska to central Mexico. At present we are really very ignorant of the conditions which presumably influence the appearance of the various color forms, and can, with security, make only rather vague generalizations. Cold weather and high altitude have comparable effects, and in general seem to produce the forms *autumnalis* and *eurytheme*. Warmer conditions bring about an increase in size and in richness of coloration, often producing, or at least being accompanied by, *eriphyle* and sometimes small *amphidusa* specimens. Hot weather is accompanied by large, richly colored *amphidusa*; but in many localities *eriphyle* continues to emerge throughout the summer and flies in company with *amphidusa*; and even specimens referable on the basis of size and color to *autumnalis* may be found flying in such mixed company.

All of the above statements are liable to frequent exception, depending on geographic location, local environment, weather, etc., so that an enormous amount of very carefully controlled

breeding work will have to be done, under experimental conditions of temperature and humidity, before the problem can begin to be understood. I very strongly suspect that some inheritance-factors will be found to enter into the matter; but in any event it cannot be denied that *eurytheme* is extremely sensitive to changes in the physical environment, and presents a very complex and as yet quite unresolved problem.

Colias astraea Edw.

A considerable number of *C. astraea* were seen, and a small series taken, in the valley of Clear Creek just below the "Natural Bridge," near the head of the lower Green River Lake on August 3. The species appears to be extremely limited in its ecological range. All of the specimens seen were in a rather peculiar, grassy-sphagnaceous type of bog, in which small clumps of willow were interspersed. Females were seen dropping into the low herbage as if ovipositing, but no definite evidence of the accomplishment of this act was secured.

The very restricted environment in which the colony was found is of considerable interest in view of the present lack of knowledge of the relationship of *astraea* to *christina* Edw. The latter species is a Lupine feeder, but there was no Lupine in the bog where these *astraea* were taken; moreover, no *astraea* were seen in contiguous territory where Lupine abounds. I strongly suspect that *astraea* and *christina* are really distinct species, and not merely forms of a single species as is usually considered to be the case.

The whole problem of the interrelationship of *christina*, *astraea*, *alexandra*, *gigantea* and *interior*, and the identification of many specimens of these species, is at present a very puzzling one. It will probably never be resolved satisfactorily until a great deal of careful breeding work, like that of Gerould on *philodice*, has been carried out. The more one studies these species by specimens alone the more one is puzzled, for perfect series of intergrades exist between most of them; and so a large percentage of specimens from the Northwest cannot be named with any assurance.

Colias alexandra Edw.

In 1935 *alexandra* was found common in nearly every suitable locality where collecting was done. It is essentially an inhabitant

of the lower half of the Canadian Zone, although specimens frequently occur in upper Transition and Canadian Zones. It thus occupies a definitely lower zonal range than *C. scudderi*. The males show an especial fondness for mud puddles, sometimes congregating in large swarms.

Definite records for 1935 are: Windsor Canyon, Cowles, N. M., July 2, very common; Hall Valley, lower end near Webster, July 15, uncommon; vic. of Estabrook, Colo., July 12, common; Pingree Park, Aug. 18-23, common in middle to lower Canadian Zone, specimens mostly worn, some quite fresh; Foxpark, Albany Co., Wyo., July 20, common in lower Canadian Zone; Green River Lake and vic. July 24-Aug. 7, uncommon, ranging from upper Transition Zone sage flats (rare) up to meadows and "parks" in mid-Canadian Zone at about 9500 ft. alt.

The large series of specimens taken at Cowles averages considerably larger than topotypical Colorado material, but definitely belongs to *a. alexandra* and not to the Great Basin race *edwardsi* Edw. Specimens from Wyoming average a bit smaller than Colorado series, are underneath somewhat more heavily suffused with greenish-fuscous, and have more traces of a pinkish ring around the discal spot of the under side of the secondaries.

Some very thorough collecting and study is needed in order to clear up the relationship of *alexandra* and *christina*. In most parts of their common range these two species are perfectly distinct; but many specimens from Idaho, Washington and southern British Columbia cannot distinctly be named as either *alexandra* (*emilia* Edw.?) or as yellow *christina*. The intergradation of the two species in this region is all the more puzzling when we consider that from east of the Continental Divide in central Montana and northern Wyoming, *alexandra* is small and heavily infuscated beneath—not at all like the *christina* from the same region. It is possible that the two forms are really not distinct in Idaho and northern Utah; but that *alexandra* was able to extend its range southward from there into New Mexico (with an offshoot westward into California), then east around the southern end of the Rockies, and northward in the Colorado mountains to Wyoming and Montana. By the time it reached there it had differentiated greatly and hence diverged from *christina* to a point of unmis-

takable specific identity. *Christina* undoubtedly does not extend very far southward in the Great Basin region; I have specimens from Payson, Utah, but none south of that point.

Colias scudderi Reakirt

C. scudderi scudderi was taken as follows: Hall Valley, July 14, 1 fresh ♂ in upper Canadian Zone meadow; Mummy Pass, July 19, 1 ♂, 1 ♀ quite fresh specimens, in Arctic-Alpine Zone, the male flying over tundra, the female in a willow bog; Pingree Park, several males, August 18-22, all badly worn; Snowy Range, July 17-23, and Aug. 13, common.

In the Snowy Range in July the species was rather common in small, grassy meadows and glades somewhat below the upper edge of the coniferous forest belt, and was only rarely present in the larger, more open, tundra and meadows in Hudsonian Zone. The majority of specimens taken at this time were fresh and recently emerged, but a few were quite worn, and had evidently been flying for a week or two. In the same locality on August 13, however, the center of distribution had moved upward, so that the species was common in the higher Hudsonian and Arctic Alpine tundra and meadows. Of 8 females taken at this locality in both July and August, 3 are light yellow, and 5 are white.

Scudderi is definitely a butterfly of the Upper Canadian and Hudsonian Zones, although during the first part of the season many specimens will be found in middle Canadian Zone. It thus contrasts strongly with *alexandra* which is practically always found in the same general localities but which is essentially of the lower and middle Canadian Zone.

I have no records of *scudderi* from north of the Snowy Range in Wyoming, west of the Uinta Mts. in Utah, or south of the Sangre de Cristo Range in northern New Mexico. Further collecting is desirable, to determine whether it occurs in any other parts of the West. *Scudderi* has always been considered as limited to Colorado, so that its presence in the Uintas is rather surprising, and holds forth the possibility that it may occur in the Wasatch Range and even reach southeastern Idaho; I strongly doubt this latter, however. The arid country of the Red Desert and southwestern Wyoming seems to be a dividing line between

northern and Colorado forms in a great many cases, and will probably prove so in this one.

***Colias scudderi ruckesi*, new geographic subspecies**

A large series of *C. scudderi* taken in Windsor Canyon in both 1935 and 1936 shows sufficient differences from *C. s. scudderi* to warrant the description of a new geographic subspecies based on this material. I name this *ruckesi* in honor of my companion in 1935, Dr. Herbert Ruckes. From *s. scudderi*, *ruckesi* differs chiefly in the following characteristics:

(1) In *ruckesi* the black marginal border of the upper side of the wings of males is proportionately wider than in *s. scudderi*.

ruckesi, 45 ♂♂

Average length of fore wing	22.68 mm.
Average width of border in cell M_1 of fore wing ...	5.786 mm.
Border-width percentage of wing-length	25.51%

scudderi, 52 ♂♂

Average length of fore wing	22.860 mm.
Average width of border in cell M_1 of fore wing ...	4.984 mm.
Border-width percentage of wing-length	21.80%

(2) In *ruckesi* the black discocellular spot of the upper side of the fore wings of males is more often reduced in size, or absent, than in *s. scudderi*.

ruckesi, 45 ♂♂

Spot present, large	2 = 4.44%
Spot present, small	11 = 24.44%
Spot present as a trace	10 = 22.22%
Spot absent	22 = 48.88%

scudderi, 52 ♂♂

Spot present, large	9 = 17.3%
Spot present, small	16 = 30.7%
Spot present as a trace	20 = 38.4%
Spot absent	7 = 13.4%

(3) The ground color of fresh specimens of *ruckesi* is a brighter, more intense yellow than that of *s. scudderi*.

(4) The black basal dusting on the upper side of the wings is somewhat heavier and more wide spread in *ruckesi* than in *s. scudderi*.

Holotype male, allotype female, nineteen male and one female paratypes, from Windsor Creek Canyon, west of Cowles, N. Mex., July 2, 1935, collected by the author. Twenty-five male and nine

female paratypes from the same locality, July 4, 1936, collected by L. E. Chadwick, Richard Whitmer and the author. All were taken in about middle Canadian Zone, at from 9000 to 9500 ft. altitude, in grassy meadows surrounded by forest, along the Forest Service trail about halfway between Cowles and the summit of Santa Fe Baldy Peak.

Holotype, allotype, six male and two female paratypes deposited in the American Museum of Natural History; four male paratypes deposited in the U. S. National Museum; four male paratypes deposited in the Canadian National collection; the remainder of the paratypes at present in the author's collection.

Although *ruckesi* is not an extremely well-marked race, I am convinced that it is worth naming. It is not to be expected that in such a race as this every specimen will be distinct from any specimen of another race; and such is the case here. In the type series of *ruckesi* are at least eight specimens which from appearance might well be *scudderi*; and I have one specimen of *s. scudderi* from Twin Lakes, Lake Co., Colo., that in appearance is a perfectly typical *ruckesi*. A series of *ruckesi* has, however, a very distinctive appearance, and is separable at a glance from a series of *s. scudderi*. In fact, with its wide, dark borders and its reduced discocellular spots, such a series is at first glance very strikingly suggestive of *C. palaeno*.

The race *ruckesi* may be taken as representing the southern part of the population of *scudderi*. I doubt that *scudderi* will be found to occur south of the Sangre de Cristo range; but if it should be taken in the Mogollon, Sierra Blanco-Sacramento or Sandia-Manzano Ranges, the more southern specimens may well prove even more different from *s. scudderi* than the type series described above.

Only eleven females were taken, a number insufficient to warrant any generalizations regarding the characteristics of this sex of *ruckesi*. Of these 5 are bright yellow, 2 are yellowish-white, and 4 are white. Of 37 females of *s. scudderi* from Colorado, Utah (Uinta Mts.) and southern Wyoming which I have studied, only 7 are definitely yellow; so this color in a larger proportion of the females may be a characteristic of *ruckesi*.

One of the females taken in 1936, when confined in a jar with samples of most of the potential food-plants of the region, laid

several eggs on willow and ignored everything else. Unfortunately the larvæ emerged in Arizona, and all succumbed to the heat of the desert, which was very understandable at the time.

Colias pelidne skinneri Barnes

Two males and a white female of this interesting form were taken at Middle Piney Lake on Aug. 10 and 11, flying along a steep, unforested hillside; one male and the female were visiting a species of *Polygonum*, and the other male was on a large, orange *Helianthus* in company with other butterflies.

It is probable that the Wyoming and Salt River Ranges mark the southern limit of distribution of *pelidne*, although there is a possibility that it may occur in the Wasatch or Uinta Mts. It almost certainly does not occur in the Colorado and contiguous ranges.

Brenthis aphirape Huebner

A series of *B. aphirape alticola* B. & McD. was taken at the type locality for this subspecies, Hall Valley, on July 15. Almost all were flying in a grass-sphagnum bog at about 11,000 ft. alt., near the upper limit of timber but in upper Canadian Zone. Only one specimen was taken outside of the limits of the bog, and that one was visiting flowers on a contiguous slope. Previous collecting in other parts of the valley had failed to reveal any specimens, but the reason for this was made evident when the rather restricted habitat of the species was discovered. All the specimens were freshly emerged.

One just-emerging, crippled male was taken in a Hudsonian Zone, grass-willow bog between Class Lake (now, in 1936, known as Lewis Lake) and the base of Medicine Bow Peak, in the Snowy Range, Wyo., on July 22, and three more specimens were taken in the same place on August 13; of these latter three, two females were quite fresh and the third, a male, was rather worn. Intensive collecting in neighboring meadows and tundra, carpeted with flowers and swarming with *Brenthis helena*, failed to reveal any more specimens; so that it seems as if here, too, *aphirape* is restricted to a bog environment.

The considerable series of topotypical *alticola* from Hall Valley as well as a number of other specimens from other Colorado

localities which I owe to the kindness of Messrs. F. M. Brown and L. E. Chadwick, enable me to here characterize *alticola* somewhat more fully than was done in the original description, especially with regard to *B. a. dawsoni* B. & McD., geographically the nearest of the other *aphirape* subspecies.

Upper side. The ground color is a lighter, more yellowish brown, the black transverse markings are narrower and more clean-cut, and the black basal dusting is less evident; there is less evidence of the presence of a hazy, zigzag, fuscous line basad of the submarginal row of round, black spots on the primaries, and distad of the outermost, zigzag, black line.

Under side. The ground color is a slightly lighter tan, but not appreciably different from that of *a. dawsoni* and *a. tricularis*.

Under side of secondaries. The dark bands (postbasal, median and submarginal) are a much lighter, orange-brown than in *dawsoni*, in which these bands, especially the postbasal and median, are darker, ranging from a dark orange-brown to a very dark reddish-brown. The submarginal dark band (immediately basad of the marginal row of triangular spots) is invariably interrupted sharply in cells M_2 and M_3 , while in *dawsoni* and *tricularis* this band is often complete. The median dark band is clear-cut, while in *dawsoni* and *tricularis* its edges, especially the outer edge, are very diffuse. The postbasal dark band is much narrower than in *dawsoni* and *tricularis*; this is especially noticeable in the spot of this band located in the discal cell, which is invariably narrower than the light spot immediately basad of it; in *dawsoni* and *tricularis* the band-spot in the cell is usually wider than the basal light spot.

The above-mentioned spot in the cell of the dark basal band may contain a light spot, but in *alticola* this is usually not the case. Of 18 specimens of *alticola* this spot is present, large and ocellate in 1, is present as a mere whitish trace in 3, and is absent in 14; of 64 specimens of *dawsoni* and *tricularis* the spot is large in 43, is present as a trace in 17, and is absent in 4.

The light, basal and submedian bands of spots are of a clear yellowish color, with a faint trace of silver in only 2 out of 18 specimens. In all 18 specimens of *alticola* the spots of the marginal row are slightly iridescent silvery, except in two in which they are strongly silvery. In *dawsoni* and *tricularis* the silvery iridescence is strongly marked in the majority of specimens in all the spots of the three bands.

In most of the above characteristics *alticola* is much more different from Manitoba (including Churchill), Alberta and Saskatchewan *dawsoni* than it is from truly Arctic specimens (mostly good *tricularis*) from Alaska and Labrador; in fact, a number of specimens from these latter regions are very close to *alticola*, and would excite no comment if taken in Colorado.

A resemblance of this kind led Leussler (Bull. Brooklyn Ent. Soc. 1935, 30: 52) to record *alticola* from the Mackenzie delta at the same time that he referred to other Arctic specimens as *dawsoni*. Such a procedure is based on an erroneous concept of the principles of subspecific taxonomy. The name "*alticola*" does not apply to *any* specimen with the *alticola* characteristics, no matter where found; it should be used solely to refer to the *population* of specimens of the species *aphirape* that occupy that *area* where *alticola* characteristics are predominant, even though occasional specimens from that area may not (phenotypically at least) possess these characteristics. Individuals from a thousand or two miles away from Colorado are a part of a population from a different area, and therefore, in this case, a part of a different subspecies. A most interesting case of this kind is described below under *B. h. helena*.

As noted above only four specimens of *aphirape* were taken in the Snowy Range, and this hardly constitutes a sufficiently large series on which to base any conclusions. It is worth recording, however, that all of these specimens are in color and pattern much closer to *dawsoni* than to *alticola*, which is far from what one would expect. Study of the distribution of *Colias* and *Brenthis* in the Rocky Mountain region shows that in the majority of cases the "break" between a Canadian race and a southern mountain race seems to come either in Montana or at the great ecological barrier of the Red Desert in Wyoming and the Great Basin lowland country in northern Utah. There is no apparent topographical, climatic, or other environmental barrier between the Snowy Range and the mountains of central Colorado where typical *alticola* occurs; so that the occurrence of *dawsoni* in the Snowy Range and of *alticola* in the contiguous ranges southward would be most surprising. Very probably more complete collecting will solve the problem.

Brenthis myrina tollandensis B. & McD.

One specimen only, a freshly emerged female, was taken; this was in a grassy marsh about three-quarters of a mile below the University of Wyoming camp, in the Snowy Range, on July 20. This agrees with the writer's previous experiences with this spe-

cies in the Rocky Mountains; it is rather rare and of very local distribution, occurring only in marshy places. It seems to emerge later in the season than the other, more typically Western species of *Brenthis*.

Brenthis kriemhild Strecker

Only one specimen of *B. kriemhild* was taken in 1935, a very badly worn female; it was in a lower Canadian Zone meadow at Green River Lake, August 5. In my experience *kriemhild* emerges somewhat earlier in the season than other species of *Brenthis* found in the same localities. It appears to be typically a lower to middle Canadian Zone species.

Records from eastern Utah and western Colorado are needed to fix the southeastern limits of the range of this species. At Payson, Utah, it is common, but I know of no more eastern records than this; it is very possible, however, that it occurs on the western slope in Colorado.

Brenthis helena Edwards

B. helena Edw. was taken at all suitable localities where collecting was done.

At Cowles, N. M., on July 2 two very fresh males were taken in a small meadow in Windsor Canyon, at about the upper middle of the Canadian Zone forest belt; this constitutes the southernmost record for the occurrence of this species of which I am aware. It also represents the lowest life-zone record I have for *helena helena*, which may be due to the fact that it was very early in the season and that the species was just beginning to emerge. One additional *Brenthis*, doubtless a *helena*, was seen on the same day in Hudsonian Zone on Santa Fe Baldy Peak at about 12,000 ft. alt. These New Mexico specimens do not appear to differ in any important respect from Colorado specimens, except that they seem brighter red beneath.

The species was found common at Hall Valley on July 15; this was in swamp and swampy meadow in upper Canadian and lower Hudsonian zones, at about 11,000 ft. alt. Many were flying and visiting flowers in company with *B. aphirape alticola*.

A considerable series of freshly emerged males, but no females, was taken in the Snowy Range from July 15 to July 23, and rep-

resented the earliest emergents of the species for the season in this locality. All were in Hudsonian Zone grassy meadows above the upper limit of the forest. On August 13 the locality was revisited, and a large series was taken, the species being found in abundance in the same environment. A number of specimens were also taken higher up on the slope of the mountains in upper Hudsonian Zone; but even at this late date no specimens at all were seen in Canadian Zone meadows, although a few hundred feet up the mountains the species was common. It is interesting to note that whereas in July only males were taken, in August the sexes were present in nearly equal numbers.

A series of *helena* was taken at Mummy Pass on August 19 and 21; all were found in Hudsonian and Arctic-Alpine zone meadows and tundra only.

A number of the specimens collected in the Snowy Range are rather peculiar and extremely interesting, for they show distinct resemblance to *B. chariclea chariclea* and *B. chariclea arctica*. On the underside of the secondaries the marginal row of spots, and the spots of the submedian light band immediately above, at the end of and below the discal cell are silvered; the remainder of the spots of the submedian band tend to be obliterated by the ground color; the spot at the end of the cell is greatly elongated and pointed; and the ground color is a rich, reddish brown with purplish shades. One of the specimens is so nearly perfect a match for a specimen of *chariclea arctica* from White Strait, Baffin Land, that either might well be mistaken for the other if the data labels were ignored.

I have long considered that *chariclea* is the closest relative of *helena* and probably represents somewhat of an ancestral form. This being so, the circumpolar *c. chariclea* and *c. arctica* might well be expected to show greater resemblance to *helena* than the more southern *c. grandis* or *c. boisduvalii*. At the close of the last glaciation, *chariclea* probably spread rapidly southward in North America, with the result that for a time all of the suitable parts of the continent would be occupied by a comparatively homogeneous population. Then as time went on, and the climate became milder, barriers would arise and isolation factors come into play; the homogeneous population would be split into a num-

ber of more or less separated populations, although these need not be actually different from each other; and opportunity for subspeciation and speciation would come. The final result, the production of such variant strains as *montinus* in New Hampshire, *boisduvalii* in Labrador and the subarctic regions, *grandis* in southern Canada, *rainieri* in Washington, *ingens* in Idaho, Montana and Wyoming, and *helena* in Colorado, Utah and New Mexico, is thus easily understandable, and presents a simple and plausible explanation of the presence of these more or less inter-related "races."

In such a case none of these forms just mentioned need be considered as ancestral to any of the others; all may be considered as divergent to a greater or lesser degree from a common, ancestral *c. chariclea-c. arctica* stock. Furthermore we must not assume that the mere accident of geographic contiguity will produce the same or close evolutionary results; for in so doing we would ignore many possibilities of divergence through the appearance of mutants. And this being so there is nothing surprising in the fact that the southernmost member of this complex, *helena*, should show a greater resemblance to the northernmost, *arctica*, than do the intermediate ones, *grandis*, *rainieri* and *boisduvalii*; or that in a population of *helena* there should occasionally arise by fortuitous combination an "atavistic" individual such as the one described above.

The same phenomenon of close similarity of a southern and an arctic race has been noted before in this paper in the case of *B. aphirape*, races *triclaria* and *alticola*. It is possible that the same explanation may apply there.

Brenthis helena ingens B. & McD.

A considerable series of *helena* taken in northwestern Wyoming (vic. Green River Lake, July 24-Aug. 7 and Middle Piney Lake and Wyoming Peak, August 9-12) may be referred to the race *ingens* B. & McD., described from the Yellowstone Park, although these specimens are not as entirely typical of this race as specimens from further north. The average length of fore-wing in a series of 34 males of *h. helena* from Colorado was found to be 18.95 mm, as contrasted with an average length of 21.08 mm in a

series of 21 males from the Wind River and Wyoming Ranges, which would place the latter series in *ingens* on size alone. In other characters they also agree with *ingens* rather than with *h. helena*.

Ingens appears to be a valid race of *helena*, though not an extremely distinct one; the characters cited in the original description all seem to hold true in series.

Judging from the material I have studied, *helena* does not intergrade to *chariclea* its nearest relative, through *ingens*, as might be expected from topographic data; instead there appears to be a closer resemblance between *h. helena* from Colorado and Utah and *c. rainieri* from Washington than between the geographically more contiguous *h. ingens* of Montana and *c. grandis* of Alberta. Study of more material from Montana, Idaho and southern Alberta may, of course, demonstrate the reverse to be true.

Brenthis freija Thunberg

Specimens of *freija* were taken at Hall Valley July 14-15, and in the Snowy Range July 17-23. In all cases they were in extreme upper Canadian and Hudsonian Zones, flying in grassy bogs and meadows. With the exception of one female from the Snowy Range all were rather badly worn, which bears out a previous conclusion of mine that *freija* is the earliest species of Rocky Mountain *Brenthis* to be on the wing. On June 8, 1933, a specimen of *freija* was taken by me on Pikes Peak, in middle Canadian Zone meadow, at 8700 ft. altitude, when no other butterflies were yet flying. This record is, incidentally, of additional interest, as being the only case known to me of a *freija* occurring below the uppermost Canadian Zone.

Dark specimens of *freija* are often erroneously identified as *tarquinius* Curtis, probably largely because of unfamiliarity with the true *tarquinius*. Study of series from Greenland and Baffinland shows that this name should be restricted to specimens from such extreme Arctic regions as these, where the population is predominantly large in size, with very heavy fuscous and chocolate-brown markings and suffusions. I have never seen a southern specimen of *freija*, even in a large series from Churchill, Manitoba, which was not easily distinguishable from the true *tar-*

quinius; although doubtless very rare accidents do occur. A considerable series from interior Alaska which I have examined are all to be classed as *freijsa* rather than as *tarquinius*. *Natazhati* Gibson, also from Alaska, is of course distinct, but is to be considered as a race of *freijsa* rather than as a distinct species as is sometimes done.

***Brenthis epithore* Edwards**

The eastward limits of the range of this species are unknown to me. Holland records the species in the "Butterfly Book" from "as far East as Colorado," but inasmuch as he considered *sagata* Barnes and Benjamin to be conspecific with *epithore*, this is not to be taken too seriously. I have one specimen from an unknown, old collection labelled "Steamboat Landing, Colorado," but the data on this may be erroneous. It is certain that if it does occur in the Great Basin and Rocky Mountain regions, *epithore* must be very rare east of the Sierras.

***Brenthis frigga* Thunberg**

The southern distribution of *B. frigga saga* Stdgr., and all the limits of distribution of *B. frigga sagata* Barnes & Benjamin are not known, and I would very much appreciate any information on the subject. In the Butterfly Book (rev. ed., p. 111) Holland errs in placing *sagata* as a synonym of *epithore*. I have seen the types and other Colorado specimens of *sagata*, and do not hesitate to state that it is unquestionably a valid, small-sized race of *frigga*, and as such is perfectly distinct from any other species of *Brenthis*.

Intensive collecting at the type locality, Hall Valley, failed to produce any specimens of *sagata* in 1935, although we were there at the right time. Possibly it occurs in some very limited environment, which we missed.